

TABLE 3

Comparison of Surface Roughness of Silicate Mold versus Metallic Glass Samples					
Sample	Composition	Sa ( $\mu\text{m}$ )	Sq ( $\mu\text{m}$ )	Variation (Sa) %	Variation (Sq) %
	Silicate Mold	0.8175	1.063	0	0
1	Zr <sub>70</sub> Cu <sub>13</sub> Ni <sub>9.9</sub> Al <sub>3.7</sub> Nb <sub>3.4</sub>	0.7225	0.8963	11.6	16.2
2	Zr <sub>67</sub> Ti <sub>8.8</sub> Ni <sub>9.8</sub> Cu <sub>10.6</sub> Be <sub>3.8</sub>	0.8023	1.100	1.9	3.5
3	Pt <sub>57.3</sub> Cu <sub>14.7</sub> Ni <sub>5.3</sub> P <sub>22.7</sub>	0.8953	1.261	9.5	18.6

**[0113]** As shown, metallic glass Zr<sub>67</sub>Ti<sub>8.8</sub>Ni<sub>9.8</sub>Cu<sub>10.6</sub>Be<sub>3.8</sub> has the smallest variation from the silicate glass, while all metallic glass samples 1-3 have variations in Sa and Sq from the silicate mold less than 20%.

**[0114]** Any metallic glass or amorphous alloy in the art may be used in connection with the methods and apparatuses described herein.

**[0115]** Any ranges cited herein are inclusive. The terms “substantially” and “about” used throughout this Specification are used to describe and account for small fluctuations. For example, they can refer to less than or equal to  $\pm 5\%$ , such as less than or equal to  $\pm 2\%$ , such as less than or equal to  $\pm 1\%$ , such as less than or equal to  $\pm 0.5\%$ , such as less than or equal to  $\pm 0.2\%$ , such as less than or equal to  $\pm 0.1\%$ , such as less than or equal to  $\pm 0.05\%$ .

**[0116]** Having described several embodiments, it will be recognized by those skilled in the art that various modifications, alternative constructions, and equivalents may be used without departing from the spirit of the invention. Additionally, a number of well-known processes and elements have not been described in order to avoid unnecessarily obscuring the invention. Accordingly, the above description should not be taken as limiting the scope of the invention. Those skilled in the art will appreciate that the presently disclosed embodiments teach by way of example and not by limitation. Therefore, the matter contained in the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense. The following claims are intended to cover all generic and specific features described herein, as well as all statements of the scope of the method and system, which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. A method of thermoplastic forming a metallic glass comprising:

placing a metallic glass on a glass mold having a portion of a surface with a fine surface texture;

heating the glass mold to a processing temperature above the glass transition temperature of the metallic glass;

applying a pressure to the glass mold; and

cooling the metallic glass to form an article replicating the fine surface texture from the portion of the glass mold.

2. The method of claim 1, wherein the fine surface texture has a surface depth in the micron range.

3. The method of claim 1, wherein the portion of the surface of the glass mold is chemically etched.

4. The method of claim 1, wherein the metallic glass comprises a material selected from a group consisting of Zr-based, Pt-based, Ni-Based, Fe-based, Ti-based, Pd-based, Au-based, Ag-based, Cu-based, Al-based, and Mo-based.

5. The method of claim 1, wherein the processing temperature is lower than the crystallization temperature of a metallic glass.

6. The method of claim 1, wherein the article is in an amorphous phase.

7. The method of claim 1, wherein the metallic glass has a TTT crystallization curve.

8. The method of claim 7, wherein a trajectory of the processing temperature versus time does not cross the TTT crystallization curve to void crystallization.

9. The method of claim 1, wherein the metallic glass comprises a metallic glass feedstock in a form of sheet, film, or rod.

10. The method of claim 1, wherein the glass mold is a silicate glass mold.

11. The method of claim 1, wherein the glass surface texture is a silicate glass surface texture.

12. A metallic glass having a fine surface texture as a glass surface texture, wherein the fine surface texture has a surface roughness ranging from 0.1  $\mu\text{m}$  to 10  $\mu\text{m}$  or a surface depth variation from  $-3 \mu\text{m}$  to 10  $\mu\text{m}$ .

13. The metallic glass of claim 12, wherein the surface depth is from  $-1 \mu\text{m}$  to 3  $\mu\text{m}$ .

14. The metallic glass of claim 12, wherein the surface roughness is from 0.1  $\mu\text{m}$  to 3  $\mu\text{m}$ .

15. The metallic glass of claim 12, wherein the metallic glass comprises a material selected from a group consisting of Zr-based, Pt-based, Ni-Based, Fe-based, Ti-based, Pd-based, Au-based, Ag-based, Cu-based, Al-based, and Mo-based.

16. The metallic glass of claim 12, wherein the fine surface texture has a surface roughness Sa within 30% of the Sa of the glass mold.

17. The metallic glass of claim 12, wherein the fine surface texture has a surface roughness Sq within 30% of the Sq of the glass mold.

18. The metallic glass of claim 12, wherein the glass surface texture is a silicate glass surface texture.

19. The metallic glass of claim 12, wherein the glass surface texture is obtained by chemical etching.

20. The metallic glass of claim 12, wherein the fine surface texture is formed from thermoplastic forming.

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